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FARMERS' BULLETIN 904
United States Department of Agriculture

FIRE

PREVENTION AND FIRE FIGHTING ON THE FARM



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FIRE-FIGHTING HINTS

ALL matches are dangerous from a fire standpoint. **SMOKING** or striking matches in barns or stables should never be allowed.

POURING gasoline or kerosene on a smoldering fire endangers life, limb, and property.

OPEN-FLAME lights should not be used in a garage or building containing a gasoline engine or gasoline in storage.

NEVER test for gas leaks with a burning match.

EVERY open fire should be watched until it is out.

FIRE attracts children; children cause many fires.

ALL oily rags should be kept in a metal container with an air-tight metal cover.

THE floor beneath stoves should have metal covering.

FIRE hazard should be considered in locating new buildings.

WOODWORK should not come in contact with any chimneys.

RESPONSIBILITY for fires rests on individuals.

This bulletin presents facts and methods which will assist farmers in reducing the large annual fire bill of the Nation, which they must assist in paying.

Office of the Secretary

Contribution from the Office of Farm Management

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FIRE PREVENTION AND FIRE FIGHTING ON THE FARM.

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MOST FIRES PREVENTABLE.

PRACTICALLY every fire, except that of incendiary origin, is preventable—some carelessness or neglect is usually responsible. Protection sufficient to prevent a fire is cheap compared with the loss entailed by the average farm fire.

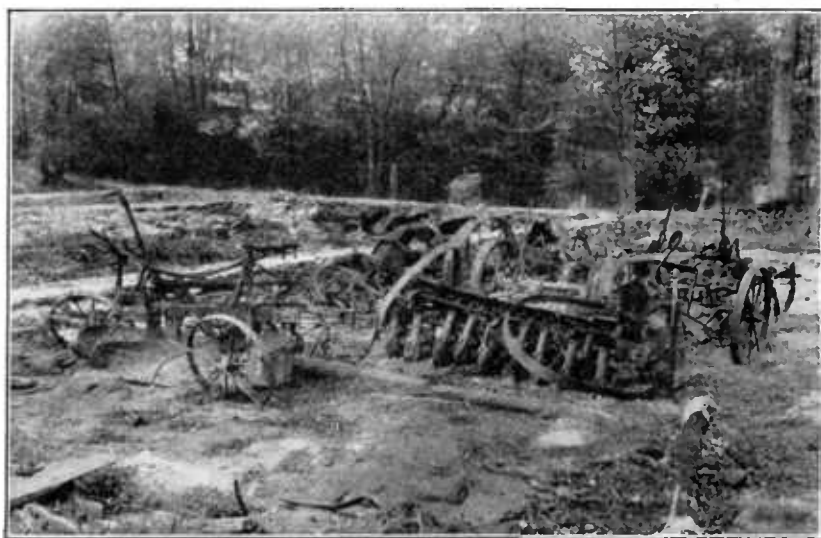


FIG. 1.—A fire on the farm usually makes a clean sweep.

Organized fire prevention long ago became a science in our cities, but there is still a tendency for many farmers to consider a destructive fire as an act of Providence and loss from fire as unavoidable.

NOTE.—Credit is due to Mr. V. N. Valgren, investigator in agricultural insurance, for valuable suggestions concerning this bulletin.

Yet a comparatively small amount of time intelligently applied by the individual farmers in the study of conditions which are likely to cause fire, and of money spent in placing simple and inexpensive fire-fighting equipment, would eliminate a large percentage of this waste. Still further reduction in fire losses on the farm would result from the general extension of organized fire protection to the rural districts. Such protection has already been provided for in many parts of California, and in a few localities in the Middle West.

The object of this bulletin is to interest the reader in fire prevention on his own premises, to induce him to investigate conditions which exist there and bring him to realize that he would be personally responsible for any fire that might occur, and to urge that he take immediate action to eliminate all unnecessary fire hazards from his premises, at the same time providing such fire-fighting facilities as conditions warrant. Suggestions are offered which will enable the farmer to study his fire problem intelligently and combine economy and efficiency in the protection of his property.

The farmer should remember that any preventive or protective measures which he may take are for his own benefit. Every building or set of buildings has certain points which are more susceptible to fires than others, but adequate protection must be provided for the entire premises before the owner can be sure that some weakness due to oversight or neglect will not neutralize the good effect of all the work previously done.

Most farmers carry fire insurance on their buildings and contents sufficient partly to repay them for any losses that may occur; but this insurance is paid from premiums which are nothing more than a tax collected from the policyholders for this purpose. The loss occasioned by a serious fire is such that very few people can afford to be without fire insurance, but attention to the prevention of fire would result in reducing the number of fires, and, therefore, the rate of premiums necessary to cover the fire losses. This would be felt quickly in mutual companies which are owned and managed by the policyholders themselves and in which the premiums are fixed by the actual losses. It would eventually result in the reduction of commercial rates on farm property, also.

FIRE PREVENTION.

The common causes of fire are known to everyone, and there is no one who does not know how to put out a fire if the means are at hand. But there is a tendency for the average property owner to become exceedingly careless in his efforts toward fire prevention and extinction.

Some of the more common fire hazards found on nearly every farm are enumerated and briefly discussed on the following pages.

The idea is not to tell the reader something new, but to make him realize that he frequently tolerates conditions which are likely to cause a destructive fire, and that he must exercise some reasonable precaution if he expects to do his share in reducing the fire bill of our Nation.

CARELESSNESS WITH MATCHES.

All matches are dangerous from a fire standpoint. The ordinary "parlor" matches take fire at a very low temperature and can be lighted in many ways. They sometimes fall to the floor unnoticed and are lighted by being stepped upon. When one is being scratched part of the flaming head may fly off into some inflammable material. Children are fond of playing with matches and do not realize the danger connected with them; even babies soon learn by imitation to strike them. Match holders should always be placed well out of reach of the younger members of the family. Many fires are started by matches carelessly thrown down while they are still in flame or before the stick has ceased to glow. At all places in the house where matches are usually struck a fireproof receptacle should be provided for the burned matches, and this should be emptied frequently. Smoking or striking matches in the barns or stables should never be allowed. Nor should hired hands or others be permitted to carry matches loose in their pockets. If the carrying of matches is necessary, insist upon the use of a good metal match safe; this will prevent single matches being pulled from the pocket accidentally.

The double-dipped matches which have come upon the market in recent years (those with heads of two colors) are much safer than the older kind, for they will not light except when scratched on the small tip, they are very unlikely to light when stepped upon, and the heads do not fly readily. But the least dangerous matches are those which will not light unless they are scratched upon the box which contains them. The manufacture and sale of single-dipped matches is recognized as undesirable by some States, which have laws forbidding it.

KEROSENE.

Kerosene is used on almost every farm in the country and has been responsible for many destructive fires. It requires quick and intelligent action to prevent an overturned lamp or lantern from setting fire to surrounding objects. Lamps with glass bodies, when overturned, frequently break and spill the oil. If lighted at the time, serious results might follow. Lamps with metal bodies are not subject to this hazard. Lamps and lanterns may explode if they are not handled carefully or if the oil gets too low in them. Some lanterns, as, for instance, switchmen's, are expressly designed to avoid danger when not handled carefully. The wick should always

fit tightly. Enough vapor to produce an explosion may be generated if a lamp or lantern is refilled while still hot. For the same reason refilling should always be done at a safe distance from a hot stove. Lamps should never be set on the floor or upon the edge of a table, box, or rickety stand. Electric lanterns, operating with one or two ordinary dry cells, such as are used on gasoline engines and automobiles, could very well take the place of many of the old kerosene lanterns in the country. These will not start fires even if handled in the most careless manner and are also much cleaner and more convenient, always ready for use, and not affected by wind or rain.

Small individual electric-lighting plants, designed particularly for farm use, can now be bought for from about \$150 up. There is practically no danger of fire from these outfits if the equipment and wiring are properly installed, and they not only eliminate the use and danger of kerosene lanterns and lamps but furnish a much better light, at the same time being cleaner, more convenient, and sanitary. In figuring the cost of installing modern lighting facilities in the home, due consideration should be given to the greater protection from fire which is entailed by such installation.

The same rules should be observed in the use of kerosene ranges and heaters as in the use of kerosene lamps and lanterns. They should always be kept free from leaks, and the flames should not be turned too high. When purchasing a portable kerosene heater, one should be selected which has a heavy base, so that it will not overturn easily. Both cookstoves and heaters which are built so that the fire is close to the floor should have pieces of sheet metal or preferably asbestos beneath them. Care is always necessary in using kerosene to aid in kindling a wood or coal fire. When starting a fire the container should always be placed at a safe distance from the stove after the kerosene has been poured on the fuel. It should never be set carelessly on top of the stove or where the flames will reach it. Pouring kerosene on a smoldering fire in order to make it burn more rapidly is very likely to cause an explosion which may set the house on fire.

Many accidents have been caused by persons using gasoline when they thought they were using kerosene. If gasoline and kerosene are both kept on the premises the containers for the two should not be alike, and it would be safer to keep them in different places.

GASOLINE—IN COMMON USE AND VERY DANGEROUS.

With the advent of the automobile, the motor truck, the tractor, and the stationary gasoline engine, gasoline has become almost as common as kerosene on the farm. This is the most dangerous petroleum product in common use. Even at ordinary temperatures it gives off a very explosive vapor, and it burns more fiercely than

kerosene. The only really safe place to keep the gasoline supply is in a tank buried underground, and it should never under any circumstances be kept inside any building where it may be necessary to take a kerosene or other open light or where a gasoline engine of any kind will be operated. If the container permits vapor to escape, a spark from the electrical equipment or a flame from the exhaust pipe of any gasoline engine may easily ignite it. The vapor from a single pint will render the air in an ordinary sized room explosive. It is heavier than air, and there may be a great deal of it near the ground or floor in the vicinity of a tank, while the odor would not be particularly noticeable to a person standing. For this reason it is especially hazardous to set a lantern on the ground or floor near a gasoline container of any kind, even out of doors, as the flame may follow the vapor from the lantern to the container.

Open-flame lights should never be allowed in the garage or the building containing the farm tractor or gasoline engine, and such a building should **never** be heated by a stove. It is safer if the automobile and tractor are run outside before the tanks are filled, so that the vapor may be carried away immediately, and the tank of a stationary gasoline engine should be filled only in daylight and while the engine is not in operation. Water, unless applied in very large quantities, has no effect on burning gasoline except to spread the fire, and this fact makes such fires all the more dangerous.

The gasoline stove is probably the most dangerous cooking or heating appliance in use on the farm. Kerosene stoves are not nearly so dangerous and fortunately they have in large measure displaced gasoline stoves. If there is a gasoline stove in the house the fuel tank should never be filled while the stove is in operation. Even then care must be taken not to spill any of the gasoline, for the vapor might cause an explosion when the stove is lighted. The tank should never be entirely filled, for the gasoline will expand somewhat as it becomes warmer, and an overflow might result.

Many destructive fires and even deaths have been caused by explosions when gasoline was being used for cleaning purposes inside the house. Often some cleaning agent which will not take fire could be used as satisfactorily as gasoline. When cleaning is done with gasoline it should never be in a room where there is a fire; the doors and the windows, if possible, should be kept open so that the vapor may escape, and the vessel containing the gasoline should not be allowed to remain uncovered. Do not use for a container a glass jar or bottle which will break if dropped or struck accidentally.

OTHER INFLAMMABLE LIQUIDS.

From a fire or explosion standpoint, benzine and naphtha are very similar to gasoline. At ordinary temperatures both of these liquids

give off very explosive vapors. They should always be handled with as much care as gasoline.

Many accidents have been caused by the careless use of benzine stove polish. Practically the only advantage of such polish is that it dries quickly, but this advantage is certainly not worth the risk attending its use. The directions usually state that the polish should not be used on a hot stove, but these are sometimes ignored, and even if the stove is cold, an open light in the room may cause an explosion. It is always better to use fireproof polish, even if it is not quite so convenient and takes a little longer to apply.

Grease used in cooking takes fire very readily when brought close to a flame and may cause serious damage. If the grease is in a frying pan the fire can be smothered by placing a metal cover over the pan. Water should not be poured on burning grease or oil of any kind, for, unless applied in large quantities, it has no effect except to spread the fire.

ACETYLENE.

Acetylene as used for lighting and occasionally for cooking in the farmhouse makes a highly explosive compound when mixed with the right proportion of air. On this account the piping and the generator must always be kept in first-class condition to prevent leakage of the gas. The selection of a good generator is important, and it will always pay to purchase one of an improved type and to see that it is installed properly.¹ A light should never be used near the generator, the system should never be tested for leaks with a flame, and a flame should never be applied to an outlet from which the burner or torch has been removed.

Acetylene is generated whenever water comes in contact with calcium carbide, and on this account it is essential that the carbide be always kept in water-tight cans in a dry and well-ventilated place.

BURNING BRUSH OR RUBBISH.

In order to get rid of undesirable brush or rubbish on the farm, it is often desirable to burn it, and at times an outdoor fire is almost a necessity. The danger from such fires in the dry season is so great that a number of the States have passed legislation requiring certain precautionary measures to reduce the hazard. In some instances permits are required from the local fire warden to set a brush fire during the fire season; in others notification to the local fire warden and neighboring owners is required, so that they may be made aware of

¹ In general, only those devices which have been inspected and labeled by the Underwriters' Laboratories (Inc.) of the National Board of Fire Underwriters should be used. The label of the Underwriters' Laboratories on any hazardous equipment or fire-fighting appliance shows that it has the official approval of practically all commercial fire insurance companies.

the fact before a fire is started. When necessity requires the burning of brush or debris in the dry season, the hazard may be reduced by burning during the early morning or the evening rather than during the heat of the day. Such a fire should be watched from the time it is kindled until the last ember is dead since fires of this type are responsible for the destruction of many buildings, fences, forests, fields of grain, etc. A fire should never be built so big that it could not be scattered and extinguished in a few minutes if the wind should happen to become dangerously high, and it should never be left until after the embers have been scattered and there is no possibility of its again flaming up. If water is convenient, the ashes should be well soaked as a final precaution. Many destructive fires have been caused by such fires which were thought to be burned out and dead, but which contained hot coals which the wind blew into flame and carried to near-by inflammable material. Children like to play around a fire, to throw things into it, or pull burning sticks from the flames. This should never be tolerated, as it is likely not only to spread the fire and cause the destruction of valuable property, but to set fire to the children's clothing and endanger human life as well. Where possible, rubbish should be burned in a brick furnace or in a metal container designed for the purpose. Metal containers having large openings around the side may be dangerous in that fire may easily get through the openings.

In some sections of the country the fertility-wasting practice of burning stubble fields and cornstalks and even straw piles before plowing is common, and the fire sometimes spreads to the adjoining fields or even into the farm buildings. This danger can be eliminated to a great extent by plowing a few furrows around the field before the fire is started. However, the practice of burning stubble, stalks, or straw should not be followed or tolerated by any farmer who considers the fertility of his soil worth money.

Bonfires, Christmas trees lighted with candles, and Fourth of July celebrations where gunpowder is used belong in the same category with rubbish fires. Any fire kindled in an unaccustomed place is likely to be dangerous. Lighted candles may be dangerous, particularly in such places as barns, closets, and attics.

FLYING SPARKS AND CINDERS.

Cinders from chimneys, locomotives, or steam traction engines often ignite dry wooden shingle roofs and start many fires in straw, stubble, and grass during dry seasons. If a railroad runs through the farm, it will nearly always pay to plow a few furrows along the right-of-way line to serve as a fire break in dry seasons. Most States have laws requiring locomotives to carry spark arresters on their smokestacks, and all steam engines on the farm should be required

to have them. When such engines are used in the stubble field or near dry grass or straw they should be watched to see that cinders from the stack or hot coals from the fire-box do not start a fire. They should always be placed as far as possible from buildings, and preferably on the side sheltered from the wind.

From a fire-protection standpoint it is unfortunate that nearly all farm buildings are covered with wooden shingles. A roof made of dry shingles, without any treatment to make them fire-resistant, is very inflammable, but on account of their durability, light weight, and low cost wooden shingles probably will continue to be used indefinitely as roofing for farm buildings. However, when a new building is being constructed or a new roof is being put on an old one it is at least worth while to consider the use of fireproof roofing, or at least the treatment of the wooden shingles to render them fire-resistant.

When shingles are exposed to the weather for a short time they take on a rough, fuzzy appearance, due to the fibers on the surface becoming loosened. The sun from without and the heat from within the building combine to extract every trace of moisture from them. If a cinder or spark happens to strike the roof the roughened surface tends to hold it there, and it is likely to set the roof on fire before it goes out. One way of lessening this danger is to paint the roof. The paint smooths down the rough surface of the wood, making it much easier for cinders to roll off to the ground when they strike the roof; it prevents the shingles from warping and forming pockets for the cinders to lodge in, and if cinders do stick on the painted surface considerably more heat is required to ignite it than to fire the rough surface of the unpainted shingles. Dried paint is mostly metallic or mineral pigment from which the oil is all evaporated, and in itself is not inflammable. Painted roofs have the advantage of being more attractive than unpainted ones, though it is a mooted question as to whether oil paint lengthens the life of a shingle roof. Where buildings are frequently exposed to danger from flying sparks or cinders, some means should be employed to make the roofs reasonably safe from them.

SPONTANEOUS COMBUSTION IN HAY.

Many destructive fires have been caused by the spontaneous ignition of hay, especially clover and alfalfa, both in mows and in stacks. The first cutting of alfalfa seems to be the most dangerous in this respect. If hay of this kind has rain or dew on it or if the stalks are not cured thoroughly when it is put up, the moisture will cause fermentation, which may produce sufficient heat to start a fire. The combustion always starts in a part of the mow or stack at some distance from the surface, but it can not continue long without oxygen from the outside, and it may cease without ever having come to the

surface. Its presence can be detected by a peculiar sooty odor or by smoke irritating to the eyes. It may take place from a few days to several weeks after the hay is put up. There is little danger from this source if the hay is properly cured. Spontaneous combustion has been known to take place in damp fodder and straw, and bins of moist grain and seeds are also dangerous in this respect. Manure piles create a great deal of heat, but manure does not burn readily.

Cloths, waste, and sawdust saturated with organic oil of any kind are even more subject to spontaneous ignition than hay. Such oils unite with oxygen when exposed to the air, and heat is produced. If the oil is spread upon cloth or other material which ignites easily, and if the conditions are such that the heat is not radiated, the temperature may become so high that a flame will be produced. The accumulation of such materials should be guarded against. Oiled mops or dust cloths used in the house and oily waste or rags used in the garage or about the barns should always be kept in metal containers with air-tight metal covers.

DEFECTIVE FLUES AND OVERHEATED STOVES.

Stoves, stovepipes, and chimneys, if improperly installed or carelessly used, always constitute a fire menace. Stoves and stovepipes should be placed at a good distance from the walls and woodwork and usually a piece of iron or tin, or preferably asbestos, should be used to cover the nearest surface. If iron or tin is used an air space should separate it from the wall or woodwork.

Stoves and stovepipes should be put up solidly. In general, stovepipes should not pass through wooden partitions or through ceilings, and in case such installation can not be avoided, a metal thimble, which can be purchased from any tinsmith or stove dealer, or a tile insulator should be placed around the pipe. Chimneys should be examined periodically for cracks. If cracks occur in a chimney they should be filled with plaster or cement at once, as fire often creeps through such cracks to the woodwork. Cracks that may be dangerous and that might not otherwise be found can be discovered by building a smudge in the stove and placing a board or wet sack over the chimney. Smoke will then be forced out of the cracks.

All chimneys and stovepipes should be cleaned regularly to remove the soot and other inflammable material that may have got into them. A chimney can best be cleaned by means of pieces of metal (such as scrap tin), limbs of an evergreen tree, or a bundle of brush attached to a rope, chain or wire, and worked up and down in the chimney from the top. A flue hole should never be filled with old cloths or other inflammable material, but should be covered in a secure manner with a metal flue-stop.

The door leading to the firebox of a stove should not be left open to check the draft, for live coals are likely to fall out on the floor, and the clothing of a person near the stove may be drawn into the fire. Suitable dampers should be provided in the pipe if the stove is not equipped with them. Open fire-places should always be provided with effective screens to keep sparks and hot coals from flying out into the room. Stoves should always be of ample size for the space they are expected to heat, for if they are too small they (and the pipe at the same time) are liable to be overheated; or if filled too full of fuel fire falls out on the floor when the door is opened.

It is important that the floor beneath the stove be protected by a metal covering. This covering should extend well out beyond the stove, especially beneath the doors to the fire-box and ash-pit, for live coals will sometimes fall out of the stove, no matter how careful one is.

POORLY CONSTRUCTED SMOKEHOUSES OFTEN TAKE FIRE.

Smokehouses for curing the family supply of meat are especially dangerous if poorly constructed of wood. It is possible to construct a smokehouse out of stone, brick, or, preferably, concrete, at only a slight increase in cost over wood, that will be practically fireproof. Needless to say, the smokehouse should be placed at some distance from the other buildings, and should be watched carefully while the meat is being smoked.

SPECIAL EQUIPMENT REQUIRING THE USE OF FIRE.

Incubators, brooders, feed-cookers, evaporators, and other equipment requiring the use of fire are found on many farms. Such equipment always constitutes a special risk. There is a great difference in the innate hazard of different types of these apparatus, and the first step in reducing the risk from them is to purchase only the best types and to make the place and manner of installation such as to involve the least danger. But wherever placed, constant care in operation is necessary to insure even comparative safety.

LIGHTNING RODS REDUCE THE DANGER FROM LIGHTNING.

The average annual property loss from lightning in the United States is about \$8,000,000, and by far the greatest part of this loss is in the rural districts. Lightning is an especially great hazard in those parts of the country where thunderstorms are frequent, and practically the only protection against it is the lightning rod. Many people hold the opinion that lightning rods do not protect a building at all, and that they actually increase the danger if they are not properly installed. But it is now definitely known that they afford

some protection in almost every case, and if they are installed properly and intelligently they reduce the risk of loss from lightning to an almost negligible quantity. From such statistics as are available regarding damage from lightning in parts of the United States and Canada where thunderstorms are frequent, it has been found that properly installed rods reduce the probability of a building being destroyed by lightning by as much as 80 or 90 per cent.

Directions for installing lightning rods are given in Farmers' Bulletin 842, *Modern Methods of Protection Against Lightning*, which may be obtained free from the Division of Publications, United States Department of Agriculture.

Farmers' mutual fire insurance companies in some instances take cognizance of the protection afforded by lightning rods and make substantial reductions on the premiums charged on rodded buildings, while others only insure buildings which are rodded in a manner satisfactory to them. Such reductions will soon pay for the cost of installation of the proper rods. In view of the fact that lightning is one of the greatest causes of fires in the rural districts, all companies which insure farm property against fire should make a considerable reduction of premiums in favor of buildings which are protected by a satisfactory system of lightning rods, and the owners of such buildings should be careful to select a company which grants such reductions.

FIRE PREVENTION IN THE ERECTION OF NEW BUILDINGS.

The fire hazard should be considered in the location and construction of all new buildings on the farm. Many groups of farm buildings are so located and constructed that any fire which might break out in one building would be almost sure to destroy the whole group. When a new building is to be erected it is worth while at least to consider placing it where it will be reasonably safe from fire starting in any other building and where it will not be a menace to other buildings.

Concrete construction is being used on many farms, and it is especially desirable for smokehouses, incubator rooms, and any other small buildings which are exceptionally subject to loss by fire. The first cost of a well-constructed concrete building generally will be greater than that of a wood building of the same size, but the concrete will last practically forever, and will seldom need paint or repairs. A fire in such a building can do but slight damage to the building itself, and there is very little likelihood of its spreading to any of the adjoining buildings.

In a building made of combustible material, the chimney should be built straight up from the ground and not placed on a bracket, as is so often the case, and should extend 2 feet or more above

the peak when the chimney is in the center of the roof and 3 feet or more above the surface when on a flat or slanting roof. For proper draft, the minimum-sized opening for the flue should be not less than 64 square inches. At the base of each flue a clean-out door should be provided, if possible. Whatever the material used in construction, it should be of good quality and laid in cement.

The joists used to support the floors through which the chimney passes should not have their ends supported in the brick, as the chimney may settle and leave cracks at these points through which fire may creep to the joists; furthermore, no other woodwork should come in contact with the chimney.

To obviate the fire hazard in brick chimneys, some good flue lining should be used in the construction, such as fire clay or terra cotta. The lining serves as a fire preventive, and gives a flue of uniform dimensions. The ordinary brick chimney will not do this. With lining, the flue presents a smooth surface upon which soot will not gather, thus eliminating to a great extent the possibility of chimney fires. The cost of such a lining for an ordinary farm residence would be nominal, and the lining should prove a cheap and effective means of fire protection.

It is possible to use fire brick in place of the fire clay or terra cotta with the same result, but at greater cost. Fire brick is more especially suited to the construction of fireplaces for lining the fire-back, sides, throat, and walls of the ash-pit.

PROTECTING WOODLAND FROM FIRE.¹

Carelessness in clearing new land, burning brush, burning over the ground for the purpose of improving grazing, smoking, and sparks from railroad engines are responsible for many destructive fires in woodland. Woods fires destroy both merchantable timber and young-tree growth and in addition burn up the rich nitrogenous leaf mold on the floor of the forest. The value of the leaf mold alone is sufficient to justify complete forest-fire protection.

Burning with the aim of improving the grazing is a costly mistake. Although green grass is afforded a week or two earlier, practically all the rich leguminous plants and annual grasses are exterminated, and only the hardiest perennials, which become of relatively little value by the impoverishment of the soil, survive.

In brush burning the brush should be piled in relatively small piles and, if the weather is dry and inflammable material is nearby, the area should be surrounded by a couple of plowed furrows to act as a fire guard. For such slash burning a day with as little wind as possible and not too dry should be chosen. If it seems desirable

¹ Contributed by the Forest Service, U. S. Department of Agriculture.

to burn around fences as a precaution against fire unexpectedly entering from other lands, the danger of fire spreading can be largely avoided by plowing a fire guard 10 or 15 feet away on one or both sides of the fence.

A number of States have established forest-fire protective systems, supported by appropriations made by the legislatures. The State foresters are generally in charge of these systems, and they have under them patrolmen who travel the regions where there is danger from forest fires. It is to the advantage of farmers owning woodland tracts to get in touch with these men and secure their assistance in keeping down the forest-fire damage.

FIRE FIGHTING.

While the easiest way to fight fire is to prevent it, and observance of the points mentioned in the preceding pages will prevent it to a great extent, some provision should be made for promptly extinguishing any fire which may start in spite of precautions. Nearly all farm products and equipment are combustible and are contained in frame buildings. It is almost a necessity that fire be maintained in some of these buildings during a part of the year and carried into most of the remaining ones occasionally. In a large percentage of cases some one is in the building when a fire starts. Thus all buildings should be equipped with some kind of fire-extinguishing apparatus, for all fires are of the same size at the start, and most of them are discovered in time to be put out by a single person if the means are at hand. The apparatus should be located in convenient places known to everyone who frequents the building, and should always be kept ready for instant use, and a ladder long enough to reach the roof should be kept in a handy place if there is no other way to get to the roof quickly. Fire insurance companies give special rates to all property owners in cities who equip their premises with satisfactory fire-extinguishing apparatus, and many companies would doubtless be willing to make similar arrangements in the case of farm buildings so equipped.

WATER.

A pail of water is the oldest, simplest, and also the cheapest fire extinguisher. Fire buckets are found in all places of business and manufacturing plants, and there is no reason why pails of water to be used for no other purpose should not be found in every farm building. They are so effective in extinguishing small fires that insurance companies grant lower rates to many merchants and manufacturers who follow this practice, yet there are very few farm buildings where buckets of water are kept in fixed places to be used

for fire only, although it would cost but little and require only a slight amount of work to maintain such protection. Most people rely on pumps to furnish water when a fire breaks out; but the well may be at a considerable distance from the fire, and the delay caused by having to hunt buckets, pump the water, and carry it to the fire may be sufficient to permit the flames to spread beyond control. The usefulness of the fire bucket depends upon its being instantly available. To insure this the water should never under any circumstances be used for other purposes, the buckets should be inspected and re-filled at regular intervals, measures should be taken to prevent the water from freezing in cold weather, and the buckets should always be kept at certain fixed places. They should be set on shelves or hung on brackets, and not put on the floor, where they may be upset or have other things piled on them. If they are provided with covers the water will not evaporate so quickly as from open buckets, nor will it get full of dust and dirt and develop an offensive smell. The water can be kept from freezing in all except very low temperatures by adding two pounds of common salt to each bucketful. In some cases calcium chloride may be preferable to common salt, as it will not cause deterioration of a metal bucket. If the buckets are specially painted or labeled they will be more conspicuous and there will be less likelihood of their being used by careless persons for other purposes than fire fighting.

In buildings which are at a considerable distance from a source of water it is advisable to install a cask or tub filled with water to reinforce the buckets. On many farms there are plenty of vessels suitable for the use mentioned which could be placed around the premises without expense and in only a few minutes' time.

A little practice in throwing water may be a very useful thing. A single bucketful if applied correctly may do more toward extinguishing a fire than a barrellful thrown awkwardly. The knack of throwing a broad sheet of water in a semicircular sweep is easily learned and is useful on a spreading fire on the floor. Water dipped out with the hands or a broom and sprinkled on the fire is often more effective than that thrown at the fire from a distance. The water should be applied to the base of the fire and not up in the flames and smoke.

The principal objections to water buckets are that they are unsightly if placed inside the house, are likely to be used for something other than fire, hold comparatively little water at the best, require a certain amount of attention if they are always to be full and ready for instant action, and are of little use on fires in oils and volatile liquids, such as gasoline or kerosene. However, they are the best form of fire protection the farmer can get for the money.

Water-supply systems which furnish water under pressure afford excellent fire-fighting facilities if the necessary hose and connections are provided and kept ready for use in emergency. This fact should be taken into account when considering the cost and advisability of installing such a system. Existing plants of this kind can be altered at small cost so as to provide additional fire-fighting facilities. While more water and higher pressure than is usually given by farm systems is required to extinguish a raging fire, a number of outlets in the pipe with short pieces of hose kept attached or always conveniently at hand will be of great value if a fire is discovered before it has gained much headway. Even the installation of an automatic sprinkling system, such as is in common use in cities, may be worth while in a large, costly farm building.

Farmers' Bulletin 941, *Water Systems for Farm Homes*, contains directions for installing water systems of different kinds, and a discussion of their value in fighting fire.

CHEMICAL EXTINGUISHERS HAVE MANY ADVANTAGES.

The chemical extinguisher has come into general use in recent years, and it has many advantages over water buckets. Since it can be used for nothing else, it is always sure to be in its place and ready when needed. Furthermore, some types of chemical extinguishers are effective in subduing fires among oils, where water is of no value.

The chemical extinguisher in most general use is the soda-acid variety with a capacity of about $2\frac{1}{2}$ gallons of water. More than 20 firms manufacture approved apparatus of this type. These apparatus generally cost from \$7 to \$12. Their construction is simple and they are easy to operate. The apparatus in most general use is about 2 feet in height and is intended to be hung on the wall. The chemical extinguishers which are approved by insurance companies are tested to withstand a pressure of 350 pounds. They are designed to hold $2\frac{1}{2}$ gallons of water mixed with $1\frac{1}{2}$ pounds of bicarbonate of soda, and a bottle which holds 4 ounces of acid. The stream which is thrown at the blaze has a range of from 25 to 40 feet and will flow for about one minute. If applied correctly the contents of a $2\frac{1}{2}$ -gallon extinguisher are equivalent to many times that volume of water thrown from pails. These extinguishers can be refilled and used many times. When not in use they require no attention, except that they should be discharged and thoroughly cleaned and refilled once a year, and must be protected from freezing. Specific directions for operating and refilling are printed upon a plate attached to the tank of all approved makes. The chemicals for refilling can be purchased at any drug store for half a dollar

or less, and a supply should always be kept on hand. These extinguishers are useful on any fire which water will quench, but are not very effective in gasoline or kerosene fires.

The purchase of a large extinguisher of this type which is mounted on wheels and which has a capacity of from 30 to 50 gallons, such as those designed primarily for use in small towns and villages, may be advisable on large plantations or ranches, and where there are a large number of buildings closely grouped together. The Department of Agriculture, in the course of an investigation of dust explosions in grain separators, developed an extinguisher of the soda-acid type, intended to afford protection irrespective of the cause of the fire or explosion. It is described in Department Bulletin 379, and the suggestion is made there that when not in use on the separator this device can be mounted on running gears and used for general fire protection about the farm.

Another type of chemical extinguisher consists of a quart of fluid in a double-action metal syringe, the handle of which is worked back and forth to eject the liquid. The chemical agent which smothers the fire is carbon tetrachloride. This is a liquid which does not freeze until a temperature of 50° F. below zero is reached. When the temperature rises to about 200° F., very nearly the temperature required to boil water, it turns into a heavy vapor, which covers and smothers the fire. It is especially useful in extinguishing fires on which water or carbonic-acid-gas extinguishers have little effect. Burning oil, gasoline, kerosene, or acetylene generally can be subdued with it and it is especially valuable in the garage. It is not poisonous and evaporates quickly without damaging articles on which it is thrown. However, a large quantity of the vapor may cause suffocation of persons remaining in a closed room with it. Caution in its use is therefore necessary. One-quart extinguishers of this type can be purchased for about \$8, and liquid for refilling them costs about \$1.50. These extinguishers are approved by all fire insurance companies.

DRY-POWDER EXTINGUISHERS.

There are on the market many makes of extinguishers consisting of sheet-metal tubes filled with powder, which decomposes when thrown on a hot fire and produces a noncombustible gas which smothers the flames by shutting off the oxygen. The manufacturers recommend them for fires in confined spaces, and especially for chimney fires, and in many cases they have been effective in curbing gasoline and oil fires. The ingredients are coarsely powdered, decompose easily without explosion, and give off a strong odor and much smoke. They appeal to many on account of their low cost when

compared with other extinguishers, but their value has been greatly exaggerated and most experts in fire protection do not recommend them. Their use in attempts to extinguish fires on which they can be of little help is likely to cause disastrous delay in the use of water or other approved agents.

"HAND GRENADE" EXTINGUISHERS.

Glass bottles of spherical form containing fire-extinguishing liquids of various kinds are sold in many places. The bottle is to be thrown on the fire and broken and the liquid thus liberated. When heated the liquid gives off a noncombustible gas, and in some cases is supposed to encrust the burning material with a fireproof chemical and thus smother the fire. These grenades are not as dependable as other forms of extinguishers. Their capacity is small, it is difficult to throw one of them to the base of the fire, and sometimes they do not break when thrown. As in the case of the tubes of dry powder, they are likely to cause serious delay in the use of better extinguishing agents.

SAND FOR EXTINGUISHING OIL FIRES.

Sand is a very good extinguisher of burning oil in case of a small fire on a floor or in a shallow container. Water is of little value in fires of this kind unless a large quantity of it is at hand, for if applied in small quantity it will generally serve only to scatter the burning material and make the fire more difficult to control. Sand is not very efficient if the fire is in a tank or bucket, since the sand sinks to the bottom of the vessel and allows the fire to keep on burning. Pails of sand are recommended in many ordinances applying to garages, and, when all things are considered, are probably superior to anything except good chemical extinguishers. Sand is very heavy, and the bucket containing it should be small or else only partly filled, so that it will not be too heavy to carry. A light, long-handled scoop or dipper might be useful for applying the sand to the fire.

SAWDUST FOR EXTINGUISHING OIL FIRES.

Sawdust is recognized as a fairly efficient extinguisher of oil fires, especially if the oil is in a deep container. Sawdust poured on burning oil floats and smothers the fire by shutting off the oxygen. Sawdust itself is somewhat inflammable, and if it is to be used care must be taken that it does not become oil-soaked and as hazardous as the oil itself. If two or three pounds of common soda is mixed with a bucketful of sawdust, it is almost entirely incombustible; and if the fire on which it is thrown is very hot the soda will give off a gas which aids in smothering the flames.

FIGHTING WOODS FIRES.¹

By the use of proper methods fire in the woods, except during very dry and windy weather, can usually be controlled. Quick action is of the utmost importance. One man who is close by at the start can often stop a fire which after a few minutes' headway would require hours or days of hard fighting by many men.

Effective ordinary tools for fighting light, running, surface fires and clearing away loose-leaf litter as a fire guard or check line are long-handled forks, shovels, and garden rakes. A rake, however, clogs up quickly. A much better tool is the long-handled, wire-bristle stable brush. Axes should be included in every fire-fighting equipment. Mattocks prove very useful in checking fire in deep forest humus, where it is necessary to dig through to the mineral soil. Various improvised substitute tools are widely made use of, often with success, in stopping fires. In the hardwood forests a stout forked stick is very commonly used to scrape away loose-leaf litter in front of an approaching fire.

Whipping is a common method of fighting lines of fire. This is particularly true in pine or other coniferous woods, where a small sapling or branch is an effective implement. A wet burlap sack does good work in whipping almost all kinds of grass or shallow ground fires. Water applied by means of a watering can will deaden a very hot fire so that a man following can readily beat out what fire remains. This method is especially well adapted to heavy grass or ground litter fires in relatively flat or smooth, rolling country, even where water has to be hauled by wagon in barrels for distances of a mile or more.

Soil thrown over the fire with a shovel checks it effectually, especially in regions of loose sandy soils free from much surface vegetable matter.

Night and early morning are the most favorable time to fight fire in the woods. Strike the advancing lines of fire by taking advantage of favorable periods of low fire, due either to lulls in the wind or small areas of sparse trees and ground cover. Don't overtax the fighting forces by attacking a fiercely burning fire front. If this sector of the fire line proves too hot and aggressive, efforts should be concentrated along the sides lines and back line, heading the fire off obliquely from each side till the two sides come together in a point.

Back-firing is a hazardous undertaking for anyone not experienced in fire fighting. Too commonly as a result of back-firing, two or more separate fires are added to the original fire, and each must be fought out. The aim should be to back-fire along narrow roadways,

¹ Contributed by the Forest Service, U. S. Department of Agriculture.

paths, or streams which if not used as guards would very likely be crossed by the fire. Back-firing should be used only when absolutely necessary. One of the most common mistakes in fighting fires is to overestimate the rapidity of the fire and the difficulty of putting it out. In back-firing property is deliberately burned over, and one should bear in mind as a fixed principle to burn over as small an area as possible.

As soon as the head fire is stopped attack the wings at once, particularly if there is a strong wind; otherwise from each wing of the old fire there will soon form an independent fire with a central head.

Go over the deadened fire line carefully and, by removing all traces of smoldering embers, make it safe against the outbreak of new fires. All snags and standing dead trees on the inside border of the burned area should be cut. If burned off at the base these might fall across the line and start a new fire, or if burning while still standing might scatter sparks beyond the line. Logs and down trees which may lie across the fire line should be rolled a safe distance back into the burned area to prevent their carrying fire across the line.

ORGANIZED RURAL FIRE FIGHTING.

The responsibility for fires, as indicated on the preceding pages, rests largely with the individual. It is his duty to himself as well as to the Nation to make reasonable efforts to remove fire hazards from his premises and to provide himself with such simple fire-fighting apparatus as come within his means. Such effort on the part of the individual farmers would most certainly greatly reduce the rural fire loss.

It should not be overlooked, however, that in spite of all reasonable efforts on the part of the individual there is still the possibility that a fire may occur and that it will not be discovered in time to be extinguishable by the individual with his own limited apparatus. For such occasions there should be available to the farmer, as well as to the city dweller, prompt assistance from organized fire fighters with necessary equipment at their command. This means that every rural community should have an organization corresponding as nearly as circumstances permit to the city fire department.

Such rural fire-fighting organizations have been developed in hundreds of communities in California during the last three years. In a number of counties the local organizations have been consolidated for purposes of general cooperation and efficiency under an official known as county fire warden. The primary purpose of these organizations in California has been to fight grain or range fires. Naturally, however, they also serve to check any fires which may occur in the buildings or on the farmstead. Two-wheeled trailers which can be at-

tached to any automobile are used to carry the fire-fighting equipment.

A few rural communities in the Middle West also have organized for fire protection. The primary purpose here has been to fight fires on the farmstead rather than those in the field, since fires of the latter sort are largely limited to States where the dry harvest season makes it possible to let the grain remain on root till thoroughly dry, when it is frequently harvested and thrashed in a single process.

The best equipped rural fire organizations are provided with auto trucks especially constructed to carry the fire-fighting apparatus, as well as several members of the force. The equipment provided where the primary purpose is to fight field fires naturally differs somewhat from that intended primarily to fight fires in buildings. In both cases, however, reliance is placed to a large extent upon chemical extinguishers.

More detailed information concerning organized rural fire protection may be found in the publications listed at the end of this Bulletin. Information and suggestions bearing on the question of organization for fire-fighting purposes in rural districts will also be given by the Department of Agriculture upon request.

PUBLICATIONS OF THE UNITED STATES DEPARTMENT OF AGRICULTURE RELATING TO THE SUBJECT OF THIS BULLETIN.

- Modern Methods of Protection Against Lightning. (Farmers' Bulletin 842.)
Dust Explosions and Fires in Grain Separators in the Pacific Northwest. (Department Bulletin 379.)
Prevailing Plans and Practices among Farmers' Mutual Fire Insurance Companies. (Department Bulletin 697.)
Organization and Management of a Farmers' Mutual Fire Insurance Company. (Department Bulletin 530.)
Farmers' Mutual Fire Insurance. (Yearbook Separate 697.)
Lightning and the Electricity of the Air. (Weather Bureau Bulletin 26.)
Recent Practice in the Erection of Lightning Conductors. (Weather Bureau Bulletin 37.)

SOME OTHER PUBLICATIONS RELATING TO FIRE PREVENTION AND PROTECTION.

- Day, W. H. Lightning Rods. Ontario Department of Agriculture, Bulletin 220. 38 pp. Toronto. 1914.
Gardner, Henry A. Fire Retardant Paints for Shingles and Other Wooden Structures. Institute of Industrial Research Bulletin 42. Washington. 1914.
Kansas State Agricultural College. Spontaneous Combustion of Alfalfa. Bulletin 109. 6 pp. Manhattan, Kans. 1902.
Peters, O. S. Protection of Life and Property Against Lightning. Technologic Papers of the Bureau of Standards No. 56. 127 pp. Washington, D. C. 1915.
Wilson, Herbert M., and Cochrane, John L. The Fire Tax and Waste of Structural Materials in the United States. U. S. Geological Survey Bulletin 418. 30 pp. Washington, D. C. 1910.
Bureau of Standards. Safety for the Household. Circular 75. 127 pp. Washington. 1918.
National Board of Fire Underwriters. Safeguarding the Home Against Fire. 91 pp. Prepared for the United States Bureau of Education.
Metcalf, Woodbridge. County Organization for Rural Fire Control. University of California Agricultural Experiment Station Circular 202. 24 pp. Berkeley, Cal. 1918.
California State Board of Forestry. Handbook of Forest Protection. Sacramento, Cal. 1918.
California Agricultural Experiment Station. Fire Protection for Grain Fields. Bulletin 295. Berkeley, Cal. 1918.

Fires cost farmers millions
annually. ■

Fight fire by preventing
it. ■

All fires are of the same
size at the start. ■

Nearly every fire is
■ preventable.